(12) UK Patent Application (19) GB (11) 2 280 348 (13) A

(43) Date of A Publication 01.02.1995

(21) Application No 9412159.7

(22) Date of Filing 17.06.1994

(30) Priority Data
(31) 9313865 (32) 05.07.1993 (33) GB

(51) INT CL[6]
A23K 1/10 , A23L 1/312

(52) UK CL (Edition N)
A2B BMA2 B821 B861

(56) Documents Cited
EP 0020849 A1

(58) Field of Search
UK CL (Edition M) A2B BKC BMA2 BMS1 BMS5
INT CL[5] A23K 1/10 , A23L 1/312
ONLINE DATABASE: WPI

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(54) Processing low value animal products

(57) A process for converting fresh, low value animal materials into feed products comprises mixing predetermined proportions of fresh, low value animal materials and pumping them through a size reducing means and mixing them in a screw type extruder with starch and protein bearing ingredients such as cereals, cereal substitutes, rice, gluten and root crops to produce a cooked extrudate and then drying the extruded material.

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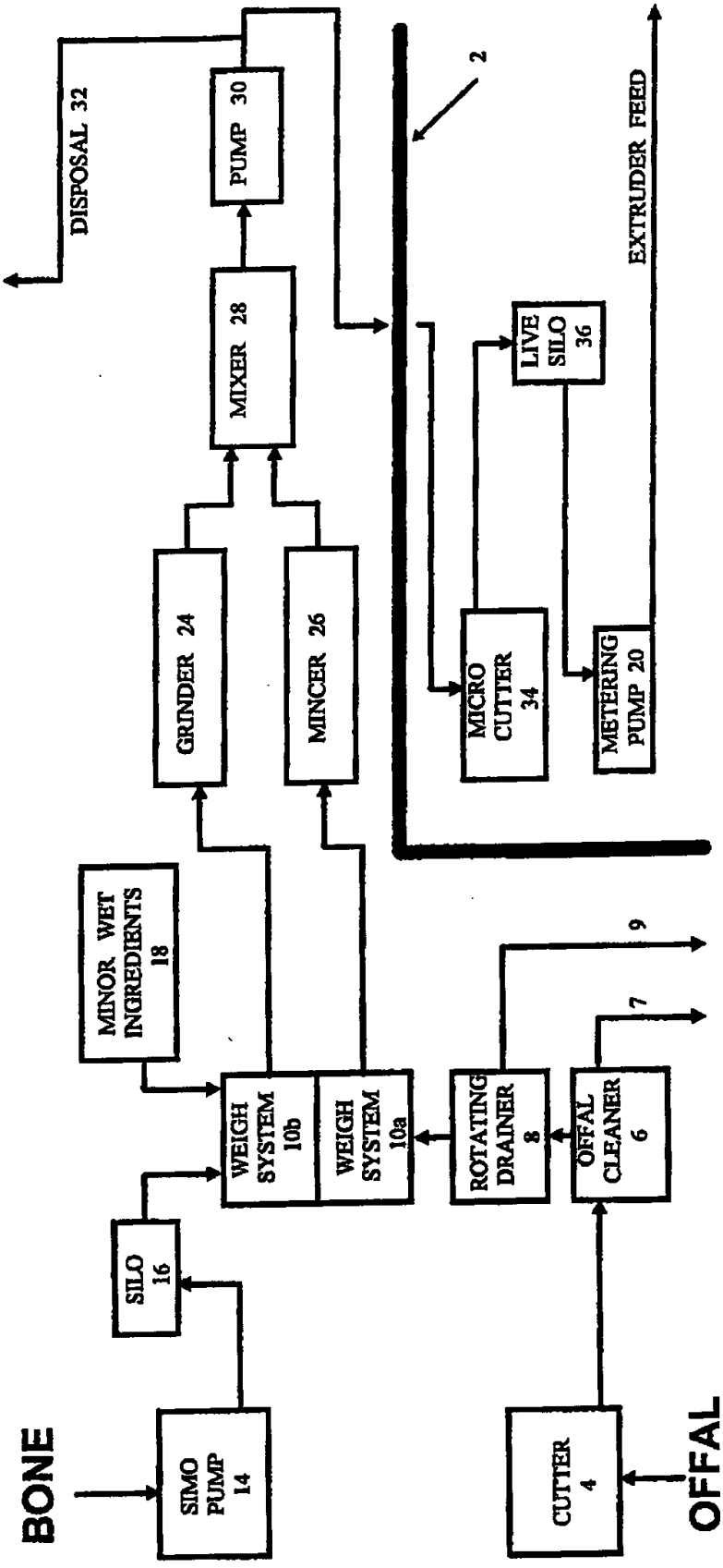
FIGURE 1


BONE
OFFAL
SIMO PUMP 14
CUTTER 4
SILO 16
WEIGH SYSTEM 10b
WEIGH SYSTEM 10a
MINOR WET INGREDIENTS 18
ROTATING DRAINER 8
OFFAL CLEANER 6
GRINDER 24
MINCER 26
MIXER 28
PUMP 30
DISPOSAL 32
MICRO CUTTER 34
LIVE SILO 36
METERING PUMP 20
EXTRUDER FEED
2
9
7

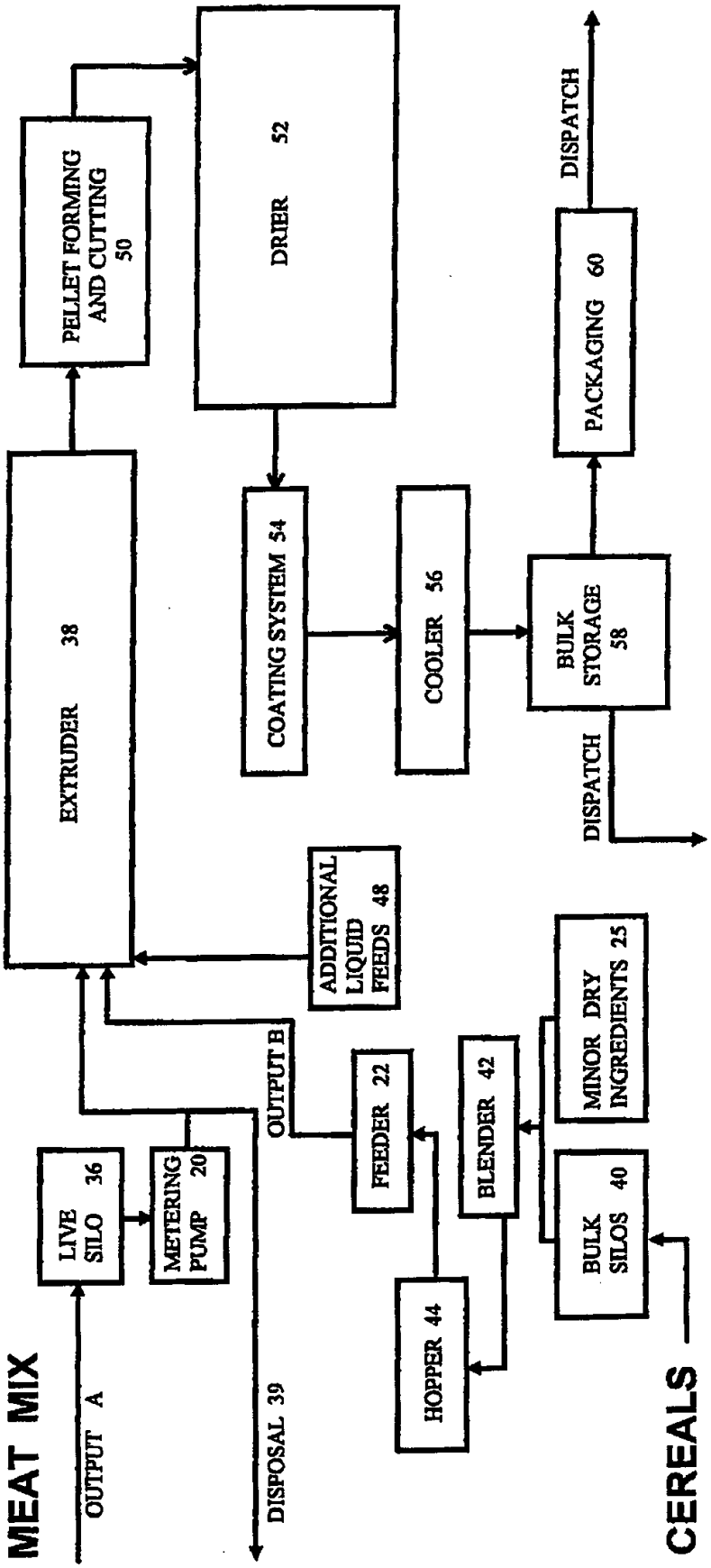

MEAT MIX
OUTPUT A
LIVE SILO 36
METERING PUMP 20
DISPOSAL 39
OUTPUT B
FEEDER 22
HOPPER 44
BLENDER 42
BULK SILOS 40
MINOR DRY INGREDIENTS 25
CEREALS
ADDITIONAL LIQUID FEEDS 48
EXTRUDER 38
PELLET FORMING AND CUTTING 50
DRIER 52
COATING SYSTEM 54
COOLER 56
BULK STORAGE 58
DISPATCH
PACKAGING 60
DISPATCH

FIGURE 2

PROCESSING LOW VALUE ANIMAL PRODUCTS

The present invention relates to a process for converting into a feed product, low value materials remaining in an animal processing plant after most of the flesh has been removed from the animal carcasses. Such materials typically include bones with meat attached and other low value products such as offal.

Traditionally this material is sold to renderers who produce from such material meat and bone meal and tallow for use in the animal feeds and cosmetic industries. Due to a restricted demand for such products, however, it is becoming increasingly difficult for meat processing plants to sell their low value material and indeed, in many cases, it is necessary for the processing plant to pay in order to dispose of it.

Off-site processing of this material is also becoming less attractive as the transport of such material is controlled in the UK under the Animal By-Products Order 1992 and equivalent legislation in other EC countries to implement Council Directive 90/667/EEC. The cost of such transport is high since 60-80% of the material is water which must be driven off during the rendering process. In practice this cost is borne by the meat processing plant.

There exists a substantial and growing technical problem for the meat industry to sell this material at a reasonable price or without incurring a loss.

Accordingly, in the present invention a process is provided which enables the low value material to be

processed at the meat processing plant thus eliminating the need for transportation and its associated cost. The process is capable of using a wet feedstock of the low value material and added ingredients and utilises all of the low value material produced, thereby eliminating storage problems prior to collection. The only unusable effluent from the process is water in the form of steam which can be readily recondensed and treated.

Depending on the added ingredients, the product can be adapted to numerous purposes, for example, sale as feed for all livestock, including pets, cattle, pigs, poultry or fish. If the processing plant is handling a single species of animal, there is the added advantage of being able to channel the resultant feedstuff exclusively into feeding different species. This is not the case for rendered meat and bone meal which contains waste material from many species. This process can also be used for production of snacks containing meat and cereals for human consumption, although it should be appreciated that a higher value meat component would be used for this application.

There are in existence various processes for producing extruded and expanded food items from various ingredients. As described in more detail herein it has been found advantageous to use a twin screw extruder. Such extruders are normally employed with a "dry" feedstock but an example of a prior art process for fish and vegetable waste using such a twin screw extruder is described in EP-A-0 169 106 (Clextral). The Clextral process teaches that moisture may be vented off half way along the extruder barrel (de-gassing) in order to reduce

the water content of this product. Nevertheless the resulting product has a water content between 15-30% at which the product would suffer from the technical problem of not being shelf-stable. The use of the extruder to dry the product as suggested in Clextral is difficult to control in terms of product expansion and uniformity. Clextral also suggests the use of relatively "soft" waste materials and does not therefore teach any essential preparation.

The present inventors have, however, appreciated that the use of an extruder as a means to significantly reduce water content as taught by Clextral is unsuitable for fresh wet animal by-products and the invention is therefore characterised in that the water content of the feedstock is controlled and the resulting expanded product is subsequently dried as a separate step in the process.

The present process therefore has the significant technical advantage that the moisture content of the material passing through the extruder is accurately controlled by further addition of water to the extruder barrel thus producing a consistent, well formed product. Although some moisture is removed as steam as the product expands, further drying must be employed to reduce the water content to levels which ensure relatively long term shelf stability.

One of the most attractive end products is pet food. Therefore the remainder of this description will be directed at a process for the manufacture of pet food, although it should be appreciated that the end product may be suitable for alternative applications. Where the

process is carried out alongside a processing plant producing meat for human consumption, there is an added advantage that the potential exists to run recipe combinations which ensure that all of the ingredients will have been passed fit for human consumption. This, together with traceability of the meat back to the origin of the animals, provides a complete account of production methods employed and an appealing quality guarantee to consumers.

An embodiment of the process will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:-

Figure 1 is a flowchart of the material preparation stages of the process; and

Figure 2 is a flowchart of the extrusion and packing stages of the process.

One of the advantages of the process to be described is that it is intended to be operated in or alongside a meat/fish/poultry processing plant taking its input directly from the low value material generated when animals are processed. Preferably these materials should not be stored prior to use, as immediate processing ensures freshness and avoids refrigeration costs. However the process can, if necessary, be used on "imported" materials. The remainder of the description assumes that the process is being carried out in or alongside a meat processing plant.

The ingredients for the process fall into two categories, those which are low value materials from meat production

carried out in the meat processing plant, and the added ingredients which include a starch and protein providing component, such as cereals, cereal substitutes, rice, gluten and oil seeds, as well as other optional ingredients added to provide flavour, texture, consistency, colour and nutritional properties.

The process consists of pre-treatment stages illustrated in Figure 1 followed by the cooking and extrusion stage illustrated in Figure 2. In the pre-treatment stages transport of the ingredients and mixtures between the various stages of the process is enclosed and may be carried out using pumps such as those manufactured by SIMO Industries A/S of Denmark (SIMO), but it will appreciated that alternative means may be used as appropriate. The SIMO pump is essentially a double chambered positive pump which also reduces the size of the material being pumped. This acts as the first stage of a size reduction process essential to the operation.

The low value material ingredients are fed to the process from the meat processing plant. Certain parts of the process are more appropriately carried out in the meat processing plant and others in a separate plant. The division between equipment located in the meat plant and the equipment which should be located in a separate plant is illustrated in Figure 1 by the line 2.

The low value animal material ingredients of the process are various offals and bone with meat attached. These two types of low value material are prepared separately and then combined into a meat paste which is mixed with added dry ingredients and liquid in an extruder. Other special

ingredients may be added at other stages during the process.

The offal is cut using a cutter 4 which takes its input directly from the meat plant. This machine will "slash" the material and facilitate cleaning in a subsequent stage. A suitable cutter is model TV90 manufactured by Loma Engineering Limited, although any machine capable of cutting the offal into thin strips would be suitable. The temperature of the offal is in excess of 30°C which makes it susceptible to rapid deterioration. The process allows prompt treatment of the offal before decay can begin and unpleasant smells develop. This gives an obvious environmental advantage over traditional methods of storing low value material until there is sufficient to be sent to a rendering plant.

The output of offal cutter 4 is delivered to an offal cleaning machine 6. A suitable machine is model 570P manufactured by La Parmentiere of France, although any machine capable of passing a flow of water over the offal and tumbling it in order to clean it would be suitable. The material entrained in the waste water is discharged into a separate output 7 where it is collected. The cleaned offal is then fed directly to a drainer 8 to remove excess water which is directed to a separate output 9 and collected. A rotating drainer manufactured by La Parmentiere of France is suitable, although any machine capable of centrifugally (or otherwise) separating water from the offal would also be suitable. It would also be possible to wash the offal by hand before processing. Ideally the water content of the washed offal will be in the range 70-90% which includes

both the intrinsic water content of the offal and the residual water remaining after the washing process. A press (not shown) may be used to reduce the water content if desired.

The output of the rotating drainer 8 discharges to a weighing system 10a. The weighing system can be a simple "eurobin" which is filled, weighed and tipped into the next stage of the process, or a more complex system employing weighing silos which can automatically discharge predetermined amounts of the ingredients into the process.

The other main low value material used is bone with meat attached which can be derived either or both from the output of a cutting/boning facility at the meat processing plant or as the residue from a mechanically recovered meat process (MRM) used to recover meat adhering to the bones. Where joints have been boned in a boning room they will typically have been chilled and therefore from this source will be cold, typically at 4-10°C. Bone from MRM will be at a higher temperature in the range 15°C to 25°C and, as in the case of the offal, can be processed promptly avoiding the need to store and refrigerate. Where boning or MRM operations are not continuous, it is possible to store the bone in a silo 16 to be used in the process during periods where no waste bone is being generated. The bone from all sources is fed via a SIMO pump 14 to a holding silo 16 and from silo 16 is discharged under gravity to the weighing system 10b. Where alternative sources of bone are used it will be appreciated that several pumps may be needed to supply system 10b. The proportion of the bone, meat, offal and

other ingredients in the output mix from the weighing system 10 is determined by the nutritional requirements of the resulting product. Where, as will normally be the case, the plant is designed to work in conjunction with a particular meat processing plant, the recipe may be tailored to take into account the proportion of bone, meat and offal that is available from processing in that plant. It is also possible to provide a control means for the operator to select one of several different preset proportions. Each preset value being for use with a specific workload of the meat processing plant. Such control means would also control a downstream metering pump 20 and feeder 22 (to be described in greater detail later) which control the relative amounts of the animal derived ingredients and the starch and protein ingredient for extrusion. A suitable control means could include a microprocessor connected to a key pad for operator input and provided with a display to confirm the input and provide operator instructions. The control means would then generate the necessary electrical signals to operate the metering devices by means of a wiring loom connected to suitable transducers.

Where the recipe of the product to be produced requires the addition of wet ingredients such as egg, tripe, vegetables or other types of low value material from the meat processing plant or elsewhere, a further silo 18 is provided. Addition of these extra ingredients at this point of the process allows them to be minced and blended accurately. For other types of ingredients addition direct to the extruder or, for dry ingredients, from a separate silo 25 coupled to the feeder 22, is preferred (to be described in greater detail later).

The next stages of the process reduce the low value ingredients to a finely minced mixture in which the particles of meat and bone are less than a predetermined maximum size. The particle size is important regarding both extrusion efficiency and appearance of the finished product. The maximum size may be in the range 0.3mm to 3mm and preferably the particles have a size range of 0.3mm to 0.5mm.

The size reduction is achieved in three stages in the process being described, although the reader will appreciate that depending on the maximum particle size to be achieved, more or less stages may be necessary or desirable.

The material from weighing system 10a is discharged into a mincer 26 which converts the offal into a free flowing slurry. A suitable mincer is Mincemaster 30 manufactured by K.S., although any machine capable of mincing offal to 6mm pieces would be suitable. The output of mincer 26 is discharged into a mixer/blender 28 which acts to completely homogenise the ingredients prior to pumping to the final size reduction stage. The output from weighing system 10b is discharged into a grinder 24 which reduces the particle size to roughly 6mm. A suitable grinder is model Weiler 1109B manufactured by Weiler, although any machine capable of grinding bone to 6mm would be suitable. The output of grinder 24 also discharges to the mixer/blender 28. A suitable mixer is model RS1300 manufactured by Risco Brevetti, although any mixer/blender capable of providing a homogeneous mixture of ground bone and offal would be suitable. The output of the mixer/blender 28 is discharged into a pump 30

which transfers the blended material for further size reduction. A suitable pump is model 5070VI manufactured by Altec Waukesha, although any pump capable of pumping a meat and bone mixture to the next stage of the process would be suitable.

If for any reason the plant is to be closed down, provision is made to connect an alternative pipe 32 to the output of pump 30 to enable the ingredients to be temporarily stored or disposed of if necessary.

The output of pump 30 discharges into a micro-cutter 34. A suitable micro-cutter is model MCH10 100A manufactured by Stephan. The micro-cutter 34 is set to cut the input mixture down to the required maximum particle size. That material which passes from the micro-cutter 34 is the output A of the mincing means and is fed into a live silo 36 for further processing. The live silo provides a buffer in the system to facilitate continuous production despite variations in the input supply. However it is not intended that the live silo 36 should be used to store material for any prolonged period and typically the time from entering to leaving the live silo will be maintained at a maximum of 60 minutes. It should be appreciated that an alternative system capable of mincing or size reduction and blending into an homogeneous "meat paste" would be suitable.

A metering pump 20 is used to draw the mix from the silo 36 at a predetermined rate. A suitable pump is model V134 manufactured by Altec Waukesha, althougn any positive pump capable of accurately pumping the meat paste would be suitable. The output of the metering pump 20 is fed to an input of an extruder 38. An alternative waste pipe 39

may be connected to pump 20 in order to divert the mix to disposal means in order to empty the plant or if the extruder cannot accept input.

The input of the extruder 38 is also fed with the input B of feed means for supplying the added ingredients, typically a blend of starch containing cereal, protein containing oil seeds or gluten and other special or minor ingredients such as vitamins, trace elements and salt.

The extrusion process needs a certain amount of water in a barrel of the extruder for cooking to proceed in a controlled fashion and for the final product to be well formed after expansion at the extruder head. The present process therefore provides for control of input moisture content such as to achieve a moisture content of up to 40% coming from the extruder. This figure represents the moisture content before additional moisture (typically 3-5%) is lost in the form of steam. The moisture content may be controlled in various ways including monitoring moisture content of the meat paste and making adjustments by addition of further liquid in the form of water, steam or blood. Oil can also be added at the extruder although oil in the extruder barrel may interfere with expansion and is therefore better added later as a coating if required by the nutritional needs of the recipe.

Bulk silo(s) 40 are used to store the major dry ingredients and the minor dry ingredients are added to a hopper 44.

A predetermined quantity of cereals, gluten, oil seeds and minor ingredients, with a particle size in the range of 0 to 3mm, are fed to a blender 42 where they are mixed

together as a batch. After blending, the contents of blender 42 are transferred to hopper 44 which acts as a buffer in the system to facilitate continuous production. A suitable blender is a ribbon blade mixer manufactured by APV Baker Ltd. The output from the hopper 44 is fed by a feeder 22 to the extruder 38. A preconditioner (not shown) can be used to treat starch based cereals to increase the extruder capacity, although this is not desirable with gluten based mixtures. The feeder 22 feeds the blended added ingredients via a conditioner or directly to output B at the required rate. A suitable feeder is commercially manufactured by APV Baker Ltd. The metering pump 20 and the feeder 22 are set such that the proportion of blended meat paste to blended dry ingredients is in the range 2:1 to 1:10.

Additional liquid ingredients are supplied via metering pumps 48. Water is added in the range 2% to 14%. Steam is added in the range 1% to 5%. Blood can be added in the range 2% to 10%. Oil can be added in the range 1% to 4%. These proportions are by volume of the total feedstock post extruder. It is necessary to have at least 25% starch in the extruder barrel in order to provide satisfactory extrusion of this blend of material, however should products of different bulk density be required, the starch content will be varied accordingly.

At the extruder 38, the dry ingredients and the meat paste mixture are combined together. The extruder 38 is a twin screw type. It should also be appreciated that any alternative system capable of mixing and metering dry and wet ingredients and feeding to the extruder would be suitable.

Twin screw extruders are well known in food and pet food processing but they normally operate on a relatively "dry" feedstock with water added to the barrel to control the cooking process. In this process the feedstock has a high water content because of the presence of the meat paste mixture, typically up to 40%, and this is regulated as previously described so that the resulting product has an output moisture content which may be in the range 35-40%. For use in this process, however, the extruder is modified. The design of the twin screw extruder allows the feedstock to be intimately mixed and cooked thoroughly. The configuration of the screws is such that clearances are smaller than normally used and consequently the amount of heat produced from friction is sufficient to produce the temperature necessary for adequate cooking and sterilisation. The combination of heat produced from friction and barrel heating allows the cooking temperature in the product to reach 110°C-140°C which also provides sterilisation of the product. The barrel temperature is maintained in the range 150-250°C. Higher temperatures may cause product burning.

Control of product quality in terms of degree of expansion and texture is achieved by the addition of varying amounts of water direct into the extruder barrel.

It has been found possible to modify for use in this process a Model MPF125 twin screw extruder manufactured by APV Baker Ltd. It will be appreciated that other designs of extruder may, by appropriate adjustment, also be suitable.

The screw configuration, found to give acceptable results, was as follows:-

4.5D Feedscrew, 4 x 60° Forward Paddles, 2D Feedscrew, 4 x 60° Forward Paddles, 3 x 60° Reverse Paddles, 1D Feedscrew, 3 x 60° Forward Paddles, 2 x 60° Reverse Paddles, 0.5D Single Leadscrew, 3 x 60° Forward paddles, 4 x 30° Reverse Paddles, 1D Single Leadscrew.

In this configuration D represents the barrel diameter and the figures given show the length of the particular sections of the screw in terms of barrel diameter. The second screw is identical to the configuration of the first so that the two screws mesh in a standard manner.

The output from the extruder is normally in the range 2 tonnes per hour to 4 tonnes per hour dependent on operating parameters and recipes, although it must be appreciated that different extruder models will give higher or lower outputs. The product discharged from the extruder 38 passes through a die-plate and cutter 50 where the product is shaped and sized. The extruded and shaped product is conveyed to a drier 52 and then through a coating system 54 to a cooler 56. The drier reduces moisture content to 10-12% at which the product is shelf stable. In the coating system 54, the hot, dried extrudate may be coated with ingredients such as oil, colour, flavour or vitamins.

The cooled product may then be stored in bulk containers 58 prior to being fed to a packaging line 60. These steps are typical of the processing of extruded products.

It will be appreciated that a substantial amount of water will be evaporated during the cooking process in the extruder and subsequently in the drier. This steam and

the washing water used in the offal cleaning machines 6 and 8 is the only effluent from the process.

The process may be automated and requires minimum operator input.

It will be appreciated that the plant described is capable of producing a complete balanced food for livestock, including pets, poultry and fish, in one continuous process from the meat, poultry or fish processing plant to finished product and providing complete traceability throughout.

CLAIMS

1. A process for converting fresh low value animal material into a feed product comprising the step of extruding it in a twin screw extruder (38) with a starch providing ingredient in order to produce an expanded cooked product, characterised in that the process further comprises a size reduction step such that the maximum particle size of the material at the input of the extruder is in the range of 0.3 to 3mm; in that the water content of the input material is controlled; and in that the resulting extruded product is dried as a separate step in the process.

2. A process as claimed in claim 1, wherein the particle size of the input animal material is in the range 0.3 to 0.5mm.

3. A process as claimed in claim 1 or 2, wherein the water content controlling step is regulated to ensure the water content at the extruder output is up to 40%.

4. A process as claimed in any one of the preceding claims, wherein the low value material is transferred from an adjacent meat, poultry or fish processing plant.

5. A process as claimed in any one of the preceding claims, wherein the starch providing ingredient is selected from cereals, cereal substitutes, oil seeds, rice or root crops.

6. A process as claimed in any one of the preceding claims, wherein the proportions of offal and bone

with meat in the low value animal material is controllable.

7. A process as claimed in any one of the preceding claims, wherein the proportions of low value animal material and starch-providing ingredient is in the range 2:1 to 1:10.

8. A process as claimed in any one of the preceding claims, wherein liquid in the form of one or more of water, steam, oil or blood is added at the extruder.

9. A process substantially as herein described with reference to the accompanying drawings.

10. A plant adapted for carrying out the process as claimed in any one of the preceding claims.

11. A plant adapted for carrying out processing of fresh low value animal material into an expanded food product comprising: mincing means (4, 14, 24, 26, 28, 30, 34) for reducing the maximum particle size of said animal material to within the range 0.3 to 3mm at an output (A); feed means (24, 40, 42, 44, 22) for supplying at an output (B) at least one additional ingredient providing starch; a twin screw extruder (38) having an input connected to the outputs (A, B) of the said mincing means and feed means and an output; liquid supply means (40) for controlling water content of the input of the extruder (38); and drying means (52) connected to the extruder output for drying the extruded expanded product.

Patents Act 1977 xaminer's report to the Comptroller under Section 17 (The Search report) 18	Application number GB 9412159.7
Relevant Technical Fields (i) UK Cl (Ed.M) A2B (BMA2; BMS1; BMS5; BKC) (ii) Int Cl (Ed.5) A23K 1/10; A23L 1/312	Search Examiner K J KENNETT Date of completion of Search 10 OCTOBER 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE: WPI	Documents considered relevant following a search in respect of Claims :- 1-11

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	EP 0020849 A1 (BEATRICE) Example 1	1,3,5,7, 10,11

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